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**Patentanmeldung Nr. | Patent application No. | Demande de brevet n°**

03250242.9

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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**R C van Dijk**

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Anmeldung Nr:
Application no.: 03250242.9
Demande no:

Anmeldetag:
Date of filing: 15.01.03
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Orienting device

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

E21B/

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL
PT SE SI SK TR LI

TS 1082 EPC

Sch

# ORIENTING DEVICE

The present invention relates to an orienting device for angularly orienting an elongated tool when moving longitudinally through the orienting device. The invention relates in particular to such a device for orienting an elongated tool when moving inside a tubular drill string. A particular application is the use in combination with a well-drilling bit suitable for through-bit operation of e.g. a logging tool.

In the specification and in the claims the expression angularly orientating will be used to refer to bringing the elongated tool into a predetermined orientation with respect to its environment by rotation of the elongated tool about its central longitudinal axis.

International Patent Application with publication number WO 00/17488 discloses a system for drilling and logging of a wellbore formed in an earth formation. The known system comprises a tubular drill string provided with a well-drilling bit at its lower end. The well-drilling bit is provided with a passageway for an elongated logging tool, and a removable closure element for the passageway in the form of an insert section at the bit face. The closure element is selectively connectable to the bit body by bit-connecting means arranged on the bit body and/or closure element. The logging tool and the closure element are provided with cooperating latching means, which allow the logging tool to connect to, and to manipulate the bit-connecting means. In this way the closure element can be removed

before the logging tool is lowered into the wellbore exterior of the well-drilling bit.

It is often desirable in such a system to angularly orient the logging tool with respect to the well-drilling bit. For example, it can be desirable to ensure a known angular reference for the logging measurements. A certain angular orientation between the logging tool and the closure element in the well-drilling bit is often preferred for a fail-safe operation of the latching means.

In particular, there is a need for an orienting device, which assures that the logging tool assumes a certain angular orientation with respect to the well-drilling bit both when it is lowered into the wellbore, and also when it is retracted again. This would allow the correct re-positioning of the closure element in the passageway of the well-drilling bit when the logging operation has been completed.

In the art of drilling it is known to use so-called mule-shoe devices, which serve to assure that equipment that is lowered in a drill string lands at a predetermined longitudinal position and angular orientation. In a mule-shoe device the landing position is determined by the cooperating action of a key and a circumferential camming rim, which camming rim is arranged so as to guide the key into a slot when the equipment is lowered into the drill string. When the key is in the slot the predetermined longitudinal position and angular orientation have been reached.

The key can be arranged to project inwardly from the inner wall of the drill string, or to project outwardly from the outer surface of the equipment, and the camming rim and slot are arranged on outer surface of the

equipment or the inner wall of the drill string, respectively.

It is an object of the present invention to provide an orienting device for angularly orienting an elongated tool when moving longitudinally inside a tubular drill string irrespective of the direction of the longitudinal motion.

It is a further object to provide a well-drilling bit suitable for through-bit operation of an elongated tool, wherein the elongated tool is angularly oriented when it is lowered into and retracted from the wellbore.

To this end there is provided an orienting device for angularly orienting an elongated tool when moving longitudinally through a passageway in the orienting device, wherein the elongated tool at its outer wall is provided with an outwardly projecting key, wherein the inner wall of the passageway is provided with two guiding rims forming a central guiding groove through which the key can pass, the guiding groove having upstream and downstream ends, further with an upstream camming rim extending from a position upstream of the guiding groove to the upstream end of the guiding groove fully around the inner wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the inner wall, wherein the camming rims and the guiding rims project sufficiently into the passageway so as to engage, when the elongated tool is moved through the tubular member, the key and to guide the key into the guiding groove, thereby angularly orienting the elongated tool.

The terms downstream and upstream in the specification and in the claims are used in relation to

the lowering of an elongated tool into a borehole, so that upstream is closer to the surface than downstream.

The upstream and downstream camming rims of the orientation device according to the invention allow orienting of the elongated tool irrespective of the direction of longitudinal motion. The central guiding groove through which the key can pass determines the angular orientation of the elongated tool, and allows the elongated tool to pass on, with a predetermined orientation, through and beyond the orienting device in either direction.

Preferably, the guiding groove is arranged substantially parallel to the central longitudinal axis, so that the angular orientation of the elongated tool after passing through the orienting device is the same irrespective of the direction of longitudinal motion.

The orienting device of the invention can suitably be arranged so that it can form part of a tubular drill string.

In particular, the passageway of the orienting device can form part of the passageway of a well-drilling bit which is suitable for through-bit operation of the elongated tool.

There is also provided a self-orienting elongated tool for assuming a predetermined angular orientation when moving longitudinally through a passageway for the elongated tool, wherein the inner wall of the passageway is provided with a radially inwardly projecting key, wherein the outer wall of the elongated tool is provided with two guiding rims forming a central guiding groove through which the key can pass, the guiding groove having upstream and downstream ends, further with an upstream camming rim extending from a position upstream of the

guiding groove to the upstream end of the guiding groove fully around the outer wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the outer wall, wherein the camming rims and the guiding rims project sufficiently outwardly from the outer wall so as to engage, when the elongated tool is moved through the passageway, the key and to guide the guiding groove over the key, thereby angularly orienting the elongated tool.

There is further provided a well-drilling bit assembly for through-bit operation of an elongated tool, which well-drilling bit assembly comprises:

- a well-drilling bit which includes a bit body attachable to a tubular drill string, which bit body is internally provided with a passageway providing communication between the interior of an attached drill string and the well exterior of the bit body, and further includes a closure element for the passageway, which closure element is selectively connectable to the bit body by bit-connecting means arranged on the bit body and/or closure element;
- an auxiliary tool for manipulating the bit-connecting means, which auxiliary tool is arranged so that it can pass from inside an attached tubular drill string along the passageway to the closure element when it is connected to the bit body,

wherein the bit body forms an orienting device according to the invention, or wherein the auxiliary tool is a self orienting tool according to the invention, there being further provided a co-operating key,

and wherein the auxiliary tool is so arranged that the bit-connecting means can be manipulated by the auxiliary tool when the key is in the guiding groove.

The invention will now be described in more detail with reference to the drawings, wherein

Figure 1 shows schematically an embodiment of an orienting device according to the invention; and

Figure 2 shows a plan view of the unrolled inner wall of the embodiment of Figure 1, obtained by cutting the tubular member along line II-II on Figure 1, and unrolling.

Reference is made to Figures 1 and 2. The orienting device 1 of this embodiment is shown as a substantially cylindrical tubular member 2 having a passageway 3 with a central longitudinal axis 4. The orienting device 1 serves for angularly orienting the substantially cylindrical elongated tool 5, when it is moved longitudinally through the passageway 3 of the orienting device 1, as indicated by the arrows 6. The orienting device during normal operation forms part of a coaxial drill string, which is not shown for the sake of clarity. The elongated tool 5 at its outer wall 8 is provided with a radially outwardly projecting key 10. The sum of the diameter of the elongated tool 5 and the radial thickness of the key 10 is smaller than the inner diameter of the cylindrical tubular member 5.

The key 10 is suitably elongated in longitudinal direction as shown in the Figure, with tapering upstream and downstream ends resulting in a boat-like shape. The key can also be formed by two parts that are spaced apart in longitudinal direction by a suitable distance. The distance can be less then, but also more than the length of the guiding groove 15.

Suitably the key is mounted on the elongated tool in such a way that it has some radial flexibility, e.g. by supporting the key by one or more springs. However, the radial flexibility should be such that even when the key is fully retracted, it extends radially far enough out such that it cannot be forced over a camming rim, so that it must be deflected.

Optionally, one or two anti-collision buttons are arranged upstream and/or downstream of the key 10 and slightly angularly displaced, like the tip shown with reference numeral 16, which is also supported by a spring.

The inner wall 12 of the tubular member is provided with a central guiding groove 15 formed by two rims 17, 18 projecting out of the inner wall 12. The spacing between the rims 17 and 18 is somewhat larger than the width of the key 10, so as to allow the key to pass through the guiding groove 15. The rims 17, 18 of this embodiment are arranged substantially parallel to the central axis 4. There is further arranged an upstream camming rim formed by the rims 22a, 22b. Each of the rims 22a, 22b forms an extension of one of the rims 17,18 from the upstream end 19 of the guiding groove 15, and spirals halfway around the inner wall 12 to a point 25 upstream of the guiding groove 15 where the rims 22a, 22b join. Substantially symmetrically to the upstream camming rim a downstream camming ream is arranged, formed by the rims 28a, 28b. Each of the rims 28a, 28b extends from one of the rims 17,18 at the downstream end 29 of the guiding groove 15, and spirals halfway around the inner wall 12 to a point 30 downstream of the guiding groove 15 where the rims 28a, 28b join.

The free diameter of the passageway 3 as defined by the rims 17,18,22a,22b,28a,28b is slightly larger than the diameter of the elongated tool 5 (not taking the thickness of the key 10 into account). The radial thickness of the key and of the rims are selected such that the key can be reliably guided by the rims, for example, in the order of 1-10 mm or more, but with careful design also smaller rims can be used. For an inner diameter of 6 cm (2.5 inch) of the tubular member, a suitable overall length from point 25 to point 30 is 25-40 cm. This allows the orienting device to be arranged as part of a shank of a well drilling bit of 15 cm (6 inch) or 21 cm (8.5 inch) diameter.

During normal operation of the orienting device of this embodiment the elongated tool 5 is lowered through the drill string of which the orienting device forms part, until the elongated tool slides into the tubular member 2 and the key 10 engages the upstream rim 22a, 22b. Should the key happen to approach exactly the point 25, the slightly angularly displaced anti-collision button 16 engages the camming rim first, and deflects the tool slightly to one side so that the key does not run against point 25. Contrary to the key 10, the anti-collision button is supported such by its spring that it can retract sufficiently so that it can run over a camming rim, for example in the case that the anti-collosion button runs against point 25.

At further lowering the rim exerts a torque on the key 10, either left-handed or right-handed depending on which of the rims 22a and 22b is engaged by the key 10. The elongated tool is thereby angularly deflected until the key slides into the guiding groove 15. With the key 10 in the guiding groove 15 the elongated tool 5 is

angularly oriented with respect to the orienting device 1 and the attached drill string.

The elongated tool can be further lowered so that the key leaves the guiding groove 15 at the side of the downstream rim. When no torque is applied on the elongated tool itself the key 10 will not normally engage the rims 28a, 28b when the elongated tool is moved completely through the passageway 3.

The elongated tool 5 can then for example be operated through a well-drilling bit suitable for through-bit operation which is attached at the downstream side of the orienting device. When the elongated tool is to be retracted again, it can in general be in an arbitrary angular orientation.

During retracting the key 10 will then engage the downstream rim 28a,28b, and the elongated tool 5 will be angularly deflected until it slides into the guiding groove 15. Since the guiding groove 15 is arranged parallel with the axis 4 of the tubular member 2, the guiding groove 15 ensures an angular orientation which is the same as it was during lowering. This is particularly advantageous when the elongated tool 5 is provided with latching/unlatching means (not shown) which cooperate with an attached well-drilling bit, so that at the position of the elongated tool 5 corresponding to the key 10 residing in the guiding groove 15 a predetermined angular orientation is ensured for correct operation of the latching/unlatching means. The latching/unlatching means is suitably designed such that the latching/unlatching functions are reversed by reversing the direction of longitudinal motion of the elongated tool. The length of the key 10, determines the exact longitudinal position of the orienting tool with respect

to the tubular member at which the predetermined angular orientation is ensured. It shall be clear that this occurs at a more downstream position when the orienting tool is retracted in upstream direction, than when inserting it in downstream direction.

The object of the invention can also be achieved in a complementary way by exchanging the roles of passageway and elongated tool. To this end the guiding rims/groove, and the upstream and downstream camming rims are arranged on the outer surface of the elongated tool, and the key is arranged on the inner surface of a passageway through which the elongated tool can pass, e.g. a tubular member such as an orienting sub of a drill string. The arrangement of the rims and guiding grooves can be analogous to the embodiment discussed with Figure 2. In particular, the elongated tool can preferably have substantially cylindrical shape with the rims projecting out of the cylindrical wall, and the plan view of the unrolled outer surface of the elongated tool can be the same as shown in Fig. 2. Such an elongated tool is self-orienting when moving longitudinally through the passageway with key on the inner wall. The elongated tool can be provided with connecting means to other equipment, so that the elongated tool can serve as an orienting means for that other equipment

The orienting device of the present invention can have the form of an orienting sub arranged in the lower part of the drill string, above the well-drilling bit. It can also form an integral part of the well-drilling bit, so that no separate orienting sub is needed. In particular it can be integrated into the passageway of a well-drilling bit suitable for through-bit operation, as

discussed above with reference to the International Patent Application with publication number WO 00/17488.

A well-drilling bit assembly for through-bit operation of an elongated tool such as a logging tool further comprises, in addition the well drilling bit, an auxiliary tool for manipulating the bit-connecting means. The auxiliary tool can be the elongated tool itself, it can be connectable to the elongated tool, or it can be separate therefrom. The auxiliary tool is arranged so that it can pass from inside an attached tubular drill string along the passageway of the well-drilling bit to the closure element, when the closure element is connected to the bit body.

In a complementary embodiment the auxiliary tool is a self-orienting tool according to the invention, and the passageway of the well-drilling bit is provided with a co-operating key.

Preferably, the cooperating guiding groove and key are so arranged that, only when the key is oriented by the guiding groove, the auxiliary tool can connect to (or disconnect from) the closure element and/or the bit-connecting means of the closure element for the passageway can be manipulated by the auxiliary tool. Since the key is elongated, the predetermined annular positioning is achieved at known and different longitudinal positions of the auxiliary tool in the drilling bit when connecting the auxiliary tool to the closure element in order to remove the closure element, and when retracting the auxiliary tool so as to re-latch the closure element into the passageway. This helps in the design of a failsafe locking/latching mechanism between auxiliary tool, closure element and bit body.

The elongated tool of the present invention can for example be a logging tool, a fluid injection tool, or a cementing stinger.

# C L A I M S

1. An orienting device for angularly orienting an elongated tool when moving longitudinally through a passageway in the orienting device, wherein the elongated tool at its outer wall is provided with an outwardly projecting key, wherein the inner wall of the passageway is provided with two guiding rims forming a central guiding groove through which the key can pass, the guiding groove having upstream and downstream ends, further with an upstream camming rim extending from a position upstream of the guiding groove to the upstream end of the guiding groove fully around the inner wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the inner wall, wherein the camming rims and the guiding rims project sufficiently into the passageway so as to engage, when the elongated tool is moved through the tubular member, the key and to guide the key into the guiding groove, thereby angularly orienting the elongated tool.

2. The orienting device according to claim 1, wherein the passageway defines a central longitudinal axis, and wherein the guiding groove is arranged substantially parallel to the central longitudinal axis.

3. The orienting device according to claim 1 or 2, wherein the upstream rim substantially defines a plane intersecting the tubular member between the upstream end of the guiding groove and the position upstream of the guiding groove, and/or wherein the downstream rim substantially defines a plane intersecting the tubular

member between the downstream end of the guiding groove and the position downstream of the guiding groove.

4. The orienting device according to any one of claims 2-3, wherein the key is elongated parallel with the central longitudinal axis.

5. The orienting device according to any one of claims 1-4, wherein upstream and/or downstream of the key an anti-collision button is arranged.

6. The orienting device according to any one of the previous claims, wherein the orienting device is arranged so that it can form part of a drill string.

7. The orienting device according to any one of the previous claims, wherein the passageway forms at least part of the passageway of a well-drilling bit which is suitable for through-bit operation of the elongated tool.

8. A self-orienting elongated tool for assuming a predetermined angular orientation when moving longitudinally through a passageway for the elongated tool, wherein the inner wall of the passageway is provided with a radially inwardly projecting key, wherein the outer wall of the elongated tool is provided with two guiding rims forming a central guiding groove through which the key can pass, the guiding groove having upstream and downstream ends, further with an upstream camming rim extending from a position upstream of the guiding groove to the upstream end of the guiding groove fully around the outer wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the outer wall, wherein the camming rims and the guiding rims project sufficiently outwardly from the outer wall so as to engage, when the elongated tool is moved through the passageway, the key and to

guide the guiding groove over the key, thereby angularly orienting the elongated tool.

9. The elongated tool according to claim 8, wherein the tubular member has a central longitudinal axis, and wherein the guiding groove is arranged substantially parallel to the central longitudinal axis.

10. The elongated tool according to claim 8 or 9, wherein the upstream rim substantially defines a plane intersecting the cylindrical member between the upstream end of the guiding groove and the position upstream of the guiding groove, and/or wherein the downstream rim substantially defines a plane intersecting the cylindrical member between the downstream end of the guiding groove and the position downstream of the guiding groove.

11. The orienting device according to any one of claims 9-10, wherein the key is elongated parallel with the central longitudinal axis.

12. A well-drilling bit assembly for through-bit operation of an elongated tool, which well-drilling bit assembly comprises:

- a well-drilling bit which includes a bit body attachable to a tubular drill string, which bit body is internally provided with a passageway providing communication between the interior of an attached drill string and the well exterior of the bit body, and further includes a closure element for the passageway, which closure element is selectively connectable to the bit body by bit-connecting means arranged on the bit body and/or closure element;
- an auxiliary tool for manipulating the bit-connecting means, which auxiliary tool is arranged so that it can pass from inside an attached tubular drill string along

the passageway to the closure element when it is connected to the bit body,

wherein the bit body forms an orienting device according to claim 7, or wherein the auxiliary tool is a self orienting tool according to any one of claims 8-11, there being further provided a co-operating key,

and wherein the auxiliary tool is so arranged that the bit-connecting means can be manipulated by the auxiliary tool when the key is oriented by the guiding groove.

# A B S T R A C T

## ORIENTING DEVICE

An orienting device for angularly orienting an elongated tool when moving longitudinally through a passageway in the orienting device, wherein the elongated tool at its outer wall is provided with an outwardly projecting key, wherein the inner wall of the passageway is provided with two guiding rims forming a central guiding groove through which the key can pass, further with an upstream camming rim extending from a position upstream of the guiding groove to the upstream end of the guiding groove fully around the inner wall, and with a downstream camming rim extending from a position downstream of the guiding groove to the downstream end of the guiding groove fully around the inner wall, wherein the camming rims and the guiding rims project sufficiently into the passageway so as to engage, when the elongated tool is moved through the tubular member, the key and to guide the key into the guiding groove, thereby angularly orienting the elongated tool.

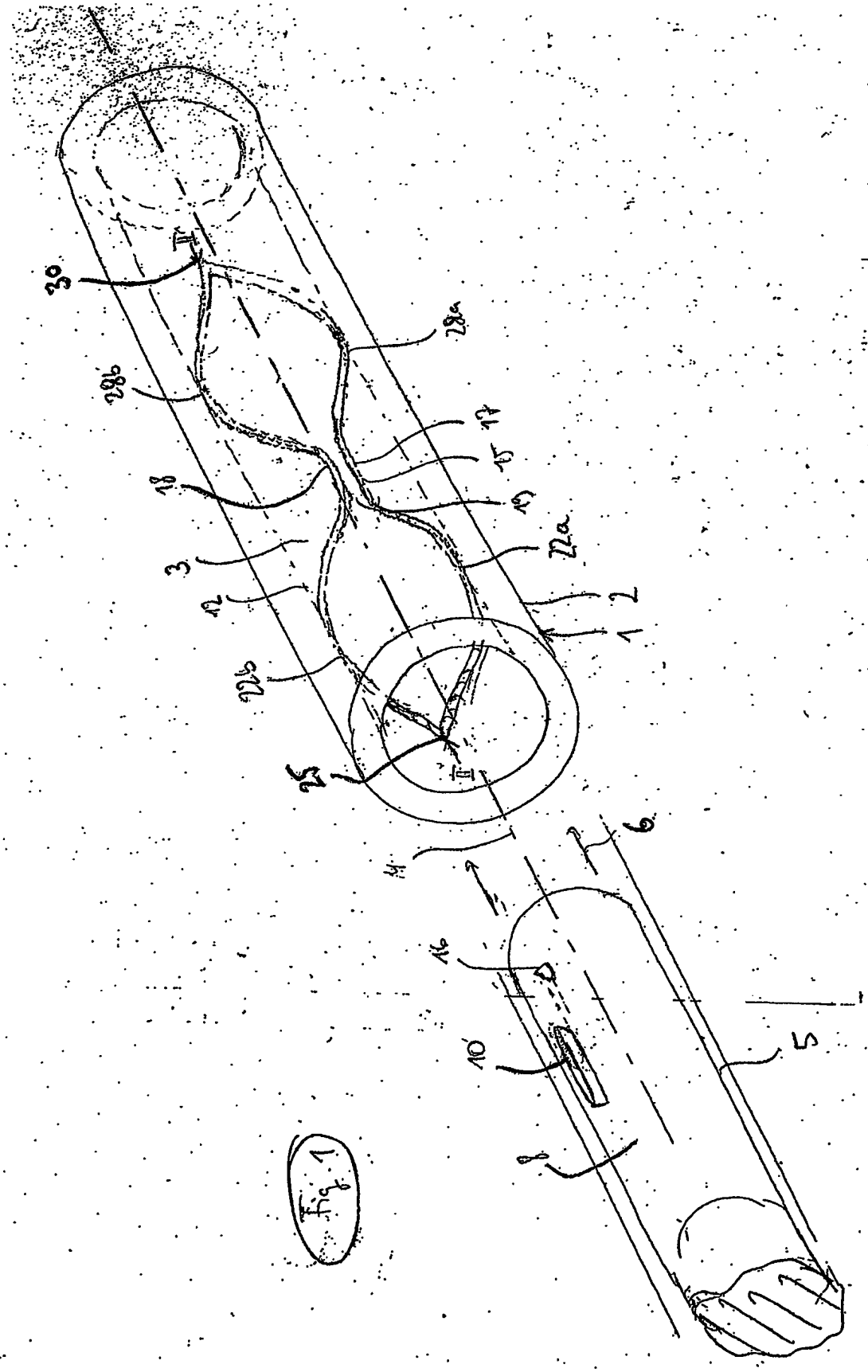


Fig 1

Fig-2